electrocardiograms and geometry information of the heart-torso, and in localizing the site of origin of cardiac activation in a clinical setting.

What is claimed is:

1. A method of imaging of electrical activities in a system comprising the steps of:

   (a) collecting signals over a part of a surface of the system using a plurality of sensors and a data acquisition unit,

   (b) determining positions of the sensors,

   (c) determining geometry information of the system,

   (d) constructing an electrical source model of the system,

   (e) estimating electrical source distribution and excitation sequence within the three dimension space of the system, by comparing and minimizing the difference between the collected signals and source model generated signals over the same sensor positions and over a certain time epoch, and

   (f) displaying the estimated electrical source distribution and excitation sequence within the three dimension space of the system, over the cross-sections of the system, together with other imaging results on the system using different procedures.

2. The method of claim 1 wherein said steps (a) to (f) are repeated for sequential time epochs.

3. The method of claims 1 wherein the system is a biological system.

4. The method of claim 1 wherein the electrical activities originate in the heart.

5. The method of claim 1 wherein the electrical activities originate in the brain.
6. The method of claim 4 wherein the electrical source model comprises a three dimension distribution of current dipoles or monopoles or electric potentials.
7. The method of claim 4 wherein the electrical source distributions in the three dimension of the heart are estimated by using weighted minimum norm strategies.
8. The method of claim 4 wherein the electrical source distributions in the three dimension of the heart are estimated by means of weighted minimum norm strategies, and further enhanced by recursive weighting algorithm, in which the weighting matrix W_k is updated by taking the product of W_{k-1} with the diagonal current matrix from the preceding step:

$$W_k = W_{k-1} \cdot diag(X_1^{k-1} X_2^{k-1} \cdots X_n^{k-1})$$

where each diagonal element of W corresponds to one element of the source.
9. The method of claim 3 wherein the electrical source model is constructed in such a way that *a priori* knowledge on the properties of physiological excitation processes are incorporated, including cellular action potentials, excitation rules, membrane patch model, and inhomogeneity properties of a biological system.
10. The method of claim 4 wherein the electrical source model is constructed in such a way that *a priori* knowledge on the properties of cardiac physiological and pathological excitation and repolarization processes are incorporated, including cellular action potentials, excitation rules, and inhomogeneity properties of myocardium.
11. The method of claim 5 wherein the electrical source model is constructed in such a way that *a priori* knowledge on the properties of brain physiological and pathological

excitation processes are incorporated, including cellular action potentials, excitation rules, and inhomogeneity properties of brain.

12. The method of claim 1 further including a step of determining the initial values of the parameters for the electrical source model, using artificial neural networks.

13. An apparatus for imaging of electrical activities in a biological system, comprising a plurality of sensors for detecting signals over a part of a surface of the biological system, means for collecting the detected signals, means for determining positions of the sensors, means for determining geometry information of the system, means for constructing an electrical source model of the system, means for estimating electrical source distribution and excitation sequence within the three dimension space of the system, by comparing and minimizing the difference between the detected signals and source model generated signals over the same sensor positions over a certain time epoch, and means for displaying the estimated electrical source distribution and excitation sequence within the three dimension space of the system, over the cross-sections of the system, together with other imaging results on the biological system using different procedures such as magnetic resonance imaging and computer tomography.

14. The apparatus of claim 13 further including means for imaging of the electrical activities for sequential time epochs.

15. The apparatus of claim 13 wherein the means for collecting the signals include an array of bioelectric electrodes.

16. The apparatus of claim 13 wherein the plurality of sensors include an array of magnetic sensors.

17. The apparatus of claim **13** wherein the plurality of sensors includes an array of magnetic sensors and an array of electrodes.

18. The apparatus of claim **13** wherein it is used together with a catheter, guiding catheter ablation of cardiac arrhythmia.